This listing of claims will replace all prior versions, and listings, of claims in the application. In amendments to the claims, additions are represented by underlining and deletions are represented by ~~strikethrough~~.

Listing of Claims

1. (previously presented) A method for producing an ultrasound image, comprising:

generating ultrasound at a frequency of at least 20 megahertz (MHz);

transmitting ultrasound at a frequency of at least 20 MHz into a subject;

receiving ultrasound from the subject; and

processing the received ultrasound to provide an image having a frame rate of at least 15 frames per second (fps).

2. (original) The method of claim 1, further comprising using the ultrasound on a small animal.

3. (original) The method of claim 2, further comprising using the ultrasound on a mouse.

4. (original) The method of claim 2, further comprising using the ultrasound on a rat.

5. (original) The method of claim 1, further comprising using ultrasound in a frequency range of 20 MHz to 60MHz.

6. (original) The method of claim 1, further comprising using the ultrasound image to guide a needle.

7. (original) The method of claim 2, further comprising imaging an organ within the small animal.

8. (original) The method of claim 7, further comprising imaging an organ chosen from a lung, a heart, a brain, a kidney, a liver and blood.

9. (original) The method of claim 7, further comprising imaging a neo-plastic condition.

10. (original) The method of claim 1, further comprising processing the received ultrasound to provide an image in real-time.

11. (original) The method of claim 1, further comprising processing the received ultrasound to provide an image having a spatial resolution of less than 30 microns (μm).

12. (original) A system for developing an ultrasound image, comprising:

a scan head having a transducer capable of generating ultrasound energy at a frequency of at least 20 megahertz (MHz); and

a processor for receiving ultrasound energy and for generating an ultrasound image at a frame rate of at least 15 frames per second (fps) and having a spatial resolution of less than 30 microns (μm).

13. (original) The system of claim 12, wherein the scan head further comprises an acoustic window over the transducer, the acoustic window having a membrane of a thickness of less than 25 microns (μm).

14. (original) The system of claim 13, wherein the acoustic window is removable.

15. (previously presented) The system of claim 14, wherein the acoustic window is chosen from a polycarbonate, a polyester, an acrylic and a polymethyl pentene.

16. (previously presented) The system of claim 13, wherein the material of the membrane is chosen from polyester, polycarbonate, acrylic, thermoplastic elastomer, silicone elastomer, Surlyn® ionomer, Surlyn® 8940, Kapton®, polymethyl pentene, TPX® MX-002, TPX® 95, MX-004; Teflon®, Mylar®, polyethylene, polycarbonate, polypropylene, and polyurethane films.

17. (previously presented) The system of claim 13, wherein the material of the membrane is low density polyethylene.

18. (original) The system of claim 13, wherein the transducer generates ultrasound energy from 20 MHz to 60 MHz.

19. (original) The system of claim 13, wherein the transducer is encapsulated in a coupling fluid and is neutrally buoyant.

20. (original) The system of claim 16, wherein the membrane prevents the transducer from directly contacting a subject.

21. (original) The system of claim 12, wherein the scanhead positions the transducer with an accuracy of at least 1 micron.

22. (original) A system for producing an ultrasound image, comprising:

means for generating ultrasound at a frequency of at least 25 megahertz (MHz);

means for transmitting the ultrasound into a subject;

means for receiving ultrasound from the subject; and means for processing the ultrasound to provide an image having a real-time frame rate of at least 15 frames per second (fps) and a spatial resolution of less than 30 microns (μm).

23. (original) The system of claim 22, further comprising means for isolating the ultrasound generating means from a subject.

24. (original) The system of claim 23, wherein the isolating means encapsulates the ultrasound generating means in a coupling fluid.

25. (previously presented) The system of claim 24, wherein the isolating means is chosen from a polycarbonate, a polyester, an acrylic and a polymethyl pentene.

26. (original) The system of claim 24, wherein the isolating means further comprises a membrane chosen from polyester, polycarbonate, acrylic, thermoplastic elastomer, silicone elastomer, Surlyn® ionomer, Surlyn® 8940, Kapton®, polymethyl pentene, TPX® MX-002, TPX® 95, MX-004; Teflon®, Mylar®, polyethylene, polycarbonate, polypropylene, and polyurethane films.

27. (original) The system of claim 24, wherein the isolating means further comprises low density polyethylene.

28. (original) The system of claim 22, further comprising means for positioning the ultrasound generating means with an accuracy of at least 1 micron.

29. (previously presented) A method for producing an ultrasound image, comprising:

generating ultrasound at a frequency of at least 25 megahertz (MHz);

transmitting ultrasound at a frequency of at least 25 MHz into a subject;

receiving ultrasound from the subject; and

processing the received ultrasound to provide an image having a real-time frame rate of at least 15 frames per second (fps) and a spatial resolution of less than 30 microns (µm).

30. (previously presented) The method of claim 1, further comprising processing the received ultrasound to provide an image having a spatial resolution of less than 100 microns (µm).

31. (previously presented) The method of claim 1, further comprising processing the received ultrasound to provide an image having a spatial resolution of 75-100 microns (µm).

32. (previously presented) The system of claim 12, wherein the ultrasound image has a spatial resolution of less than 100 microns (µm).

33. (previously presented) The system of claim 12, wherein the ultrasound image has a spatial resolution of 75-100 microns (µm).

34. (previously presented) The system of claim 22, wherein the image has a spatial resolution of less than 100 microns (µm).

35. (previously presented) The system of claim 22, wherein the image has a spatial resolution of 75-100 microns (µm).

36. (previously presented) The method of claim 29, further comprising processing the received ultrasound to provide an image having a spatial resolution of less than 100 microns (µm).

37. (previously presented) The method of claim 29, further comprising processing the received ultrasound to provide an image having a spatial resolution of 75-100 microns (µm).

38. (previously presented) A system for developing an ultrasound image, comprising:

a scan head having a transducer capable of generating ultrasound energy at a frequency of at least 20 megahertz (MHz); and

a processor for receiving ultrasound energy and for generating an ultrasound image at a frame rate of at least 15 frames per second (fps).

39. (previously presented) The system of claim 38, further comprising an ultrasound image having a spatial resolution of less than 100 microns (μm).

40. (previously presented) The system of claim 38, further comprising an ultrasound image having a spatial resolution of 75-100 microns (μm).

41. (previously presented) A system for producing an ultrasound image, comprising:

means for generating ultrasound at a frequency of at least 25 megahertz (MHz);

means for transmitting the ultrasound into a subject;

means for receiving ultrasound from the subject; and

means for processing the ultrasound to provide an image having a real-time frame rate of at least 15 frames per second (fps)

42. (previously presented) The system of claim 41, further comprising an ultrasound image having a spatial resolution of less than 100 microns (μm).

43. (previously presented) The system of claim 41, further comprising an ultrasound image having a spatial resolution of 75-100 microns (μm).

44. (currently amended) A scanhead comprising:

a transducer assembly comprising a transducer for generating ultrasound at a frequency of at least about 20MHz, the transducer having a distal face;

a pivot frame having a front end ~~distal end~~;

a rotor assembly comprising a pivot tube having a distal end, the transducer assembly being mounted to the distal end of the pivot tube;

a means for pivotably mounting the rotor assembly to the pivot frame;

a nosepiece comprising a proximal end, a distal end that defines a window opening, and an acoustic window that is mounted in the window opening to seal the distal end of the nosepiece, the nosepiece further defining an interior cavity, and the proximal end of the nosepiece being attachable to the front ~~distal~~ end of the pivot frame to define an enclosed volume, wherein at least a portion of the pivot tube and the transducer are positioned therein the enclosed volume.

45. (previously presented) The scanhead of claim 44, further comprising a means for oscillating the rotor assembly in a predetermined operating plane.

46. (previously presented) The scanhead of claim 45, wherein the acoustic window has an elongate dimension extending along a window axis, and wherein, in use, the window axis of the acoustic window is positioned in the predetermined operating plane.

47. (previously presented) The scanhead of claim 46, wherein the window axis has an arcuate cross-sectional shape, such that when the rotor assembly oscillates, the transducer pivots in proximity to at least a portion of the inner surface of the acoustic window.

48. (previously presented) The scanhead of claim 46, wherein the distal face of the transducer is spaced from the interior surface of the acoustic window from about at least 0.5 millimeters (mm).

49. (previously presented) The scanhead of claim 46, wherein at least a portion of the transducer contacts at least a portion of interior surface of the acoustic window.

50. (previously presented) The scanhead of claim 45, wherein the pivot frame has a pivot axis about which the rotor assembly pivots, wherein the pivot frame has an operating axis that bisects the window axis of the acoustic window and the pivot axis of the pivot frame, and wherein the means for ocillating the rotor assembly moves the transducer through an acute angle with respect to the operating axis.

51. (previously presented) The scanhead of claim 50, wherein the means for ocillating the rotor assembly moves the transducer above and below the operating axis within the operating plane.

52. (previously presented) The scanhead of claim 51, wherein the acute angle on either side of the operating axis is less than or equal to about 22°.

53. (previously presented) The scanhead of claim 45, wherein the transducer assembly is pivoted within the enclosed space at a frequency of about 7.5 Hz or greater.

54. (previously presented) The scanhead of claim 45, wherein the transducer assembly is pivoted within the enclosed space at a frequency of about 15 Hz or greater.

55. (previously presented) The scanhead of claim 44, wherein the enclosed volume is at least partially filled with a fluid.

56. (previously presented) The scanhead of claim 55, wherein the nosepiece further defines a fill port in communication with the interior cavity for introducing or removing the fluid from the enclosed volume.

57. (previously presented) The scanhead of claim 55, wherein the fluid has an impedance substantially similar to the impedance of tissue.

58. (previously presented) The scanhead of claim 55, wherein the fluid is a glycol.

59. (previously presented) The scanhead of claim 55, wherein the fluid is water.

60. (previously presented) The scanhead of claim 55, wherein the fluid is selected from the group consisting of: water, ethylene glycol, triethylene glycol, and light paraffin oil.

61. (previously presented) The scanhead of claim 55, wherein the acoustic window is acoustically matched to the fluid.

62. (currently amended) The scanhead of claims 44 or 55, wherein the acoustic window has an impedance of between about 1.0 megaRayles and 3.3 megaRayles.

63. (currently amended) The scanhead of claims 44 or 55, wherein the acoustic window has an impedance of between about 1.5 megaRayles and 1.8 megaRayles.

64. (previously presented) The scanhead of claim 44, wherein the acoustic window comprises a material selected from the group consisting of: polyester, polycarbonate, acrylic, thermoplastic elastomer, silicone elastomer, laytex elastomer, Surlyn® ionomer, Surlyn® 8940, Kapton®, polymethyl pentene, TPX® MX-002, TPX® 95, MX-004; Teflon®, Mylar®, polyethylene, polytetrafluoroethylene, polycarbonate, polypropylene, and polyurethane films.

65. (previously presented) The scanhead of claim 44, wherein the acoustic window comprises low density polyethylene.

66. (previously presented) The scanhead of claim 44, wherein at least a portion of the ultrasound generated by the transducer contacts and penetrates the acoustic window.

67. (previously presented) The scanhead of claim 44, wherein the acoustic window has a thickness of about 0.9 microns (μm) to about 60.0 microns (μm).

68. (previously presented) The scanhead of claim 44, wherein the transducer is a broadband transducer.

69. (previously presented) The scanhead of claim 44, wherein the transducer generates ultrasound at a frequency selected from the group consisting of 30MHz, 40MHz and 50MHz.

70. (previously presented) The scanhead of claim 44, wherein the transducer generates ultrasound at a frequency of at least about 30MHz.

71. (previously presented) The scanhead of claim 44, further comprising a positioning means for tracking the position of the pivot tube.

72. (previously presented) The scanhead of claim 71, wherein the position of the distal end of the pivot tube is tracked to within about 1.0 micron (μm).

73. (previously presented) The scanhead of claim 44, wherein the at least a portion of the pivot tube and the transducer that are positioned therein the enclosed volume are neutrally buoyant.

74. (previously presented) A system for developing an ultrasound image, comprising:

a scanhead having a transducer capable of generating ultrasound energy at a frequency of at least about 20 megahertz (MHz) and having a nosepiece comprising a distal end that defines an elongate window opening and an elongate acoustic window that is mounted therein the window opening to seal the distal end of the nosepiece, wherein at least a portion of the ultrasound generated by the transducer contacts and penetrates the acoustic window; and

a processor for receiving ultrasound energy and for generating an ultrasound image at a frame rate of at least 15 frames per second (fps).

75. (previously presented) The system of claim 74, further comprising an ultrasound image having a spatial resolution of less than about 100 microns (μm).

76. (previously presented) The system of claim 74, further comprising an ultrasound image having a spatial resolution of between about 25 microns (μm) to about 100 microns (μm).

77. (new) A method for producing an ultrasound image, comprising:

generating ultrasound at a frequency of at least 20 megahertz (20MHz) using a single element ultrasonic transducer;

moving the transducer along a predetermined path;

transmitting ultrasound from the ultrasonic transducer at a frequency of at least 20 MHz at a plurality of locations along the predetermined path into a subject;

receiving ultrasound from the subject with the transducer at a plurality of locations along the predetermined path; and

processing the received ultrasound to provide an image having a frame rate of at least 15 frames per second (fps).

78. (new) The method of claim 77, wherein at least a portion of the transmitted ultrasound penetrates a membrane before being transmitted into the subject.

79. (new) The method of claims 77 or 78, wherein the ultrasound is transmitted into the subject from a location external to the subject.

80. (new) The method of claim 78, wherein the membrane is an acoustic window operatively mounted in a window opening of a scanhead nosepiece.

81. (new) The method of claim 80, wherein the acoustic window is mounted in the window opening to seal the distal end of the scanhead nosepiece to define an enclosed volume, wherein at least a portion the transducer is positioned therein the enclosed volume.

82. (new) The method of claim 81, wherein the enclosed volume is at least partially filled with a fluid.

83. (new) The method of claim 77, wherein the predetermined path is arcuate in shape.

84. (new) The method of claim 83, wherein the transducer oscillates along the arcuate path at a frequency of at least 15Hz.

85. (new) The method of claim 77, wherein the ultrasound image has a spatial resolution of less than about 100 microns (μm).

86. (new) The method of claim 77, wherein the ultrasound image has a spatial resolution of between about 25 microns (μm) to about 100 microns (μm).

87. (new) The method of claim 77, wherein the ultrasound image has a spatial resolution of between about 75 microns (μm) to about 100 microns (μm).

88. (new) A system for producing an ultrasound image, comprising:

a single element ultrasonic transducer for generating ultrasound at a frequency of at least 20 megahertz (20MHz), for transmitting at least a portion of the generated ultrasound into a subject and for receiving ultrasound energy from the subject;

a means for moving the transducer along a predetermined path;

a processor for processing the received ultrasound to provide an image having a frame rate of at least 15 frames per second (fps).

89. (new) The system of claim 88, wherein at least a portion of the transmitted ultrasound penetrates a membrane before being transmitted into the subject.

90. (new) The system of claims 88 or 89, wherein the ultrasound is transmitted into the subject from a location external to the subject.

91. (new) The system of claim 89, wherein the membrane is an acoustic window operatively mounted in a window opening of a scanhead nosepiece.

92. (new) The system of claim 91, wherein the acoustic window is mounted in the window opening to seal a distal end of the scanhead nosepiece to define an enclosed volume, wherein at least a portion the transducer is positioned therein the enclosed volume.

93. (new) The system of claim 92, wherein the enclosed volume is at least partially filled with a fluid.

94. (new) The system of claim 88, wherein the predetermined path is arcuate in shape.

95. (new) The system of claim 94, wherein the transducer oscillates along the arcuate path at a frequency of at least 15Hz.

96. (new) A method for producing an ultrasound image, comprising:

generating ultrasound at a frequency of at least 20 megahertz (20MHz) using a single element ultrasonic transducer;

transmitting ultrasound from the ultrasonic transducer at a frequency of at least 20 MHz through a membrane and into a subject;

receiving ultrasound from the subject with the transducer; and

processing the received ultrasound to provide a Doppler image.

97. (new) The method of claim 96, wherein the ultrasound is transmitted into the subject from a location external to the subject.

98. (new) The method of claim 96, wherein the membrane is an acoustic window operatively mounted in a window opening of a scanhead nosepiece.

99. (new) The method of claim 97, wherein the acoustic window is mounted in the window opening to seal a distal end of the scanhead nosepiece and to define an enclosed volume, wherein at least a portion of the transducer is positioned therein the enclosed volume.

100. (new) The method of claim 99, wherein the enclosed volume is at least partially filled with a fluid.

101. (new) A method for producing an ultrasound image, comprising:

generating ultrasound at a frequency of at least 20 megahertz (20MHz) using a single element ultrasonic transducer;

transmitting ultrasound from the ultrasonic transducer at a frequency of at least 20 MHz, through a membrane, and into a subject;

receiving ultrasound from the subject with the transducer; and

processing the received ultrasound to provide an M-mode image.

102. (new) The method of claim 101, wherein the ultrasound is transmitted into the subject from a location external to the subject.

103. (new) The method of claim 101, wherein the membrane is an acoustic window operatively mounted in a window opening of a scanhead nosepiece.

104. (new) The method of claim 103, wherein the acoustic window is mounted in the window opening to seal a distal end of the scanhead nosepiece and to define an enclosed volume, wherein at least a portion of the transducer is positioned therein the enclosed volume.

105. (new) The method of claim 104, wherein the enclosed volume is at least partially filled with a fluid.

106. (new) The method of claim 101, wherein the ultrasound image has a spatial resolution of less than about 100 microns (μm).

107. (new) The method of claim 101, wherein the ultrasound image has a spatial resolution of between about 25 microns (μm) to about 100 microns (μm).

108. (new) The method of claim 101, wherein the ultrasound image has a spatial resolution of between about 75 microns (μm) to about 100 microns (μm).

109. (new) A system for producing an ultrasound image, comprising:

a single element ultrasonic transducer for generating and transmitting into a subject ultrasound at a frequency of at least 20 megahertz (MHz) and for receiving ultrasound from the subject, wherein the ultrasonic transducer can be moved relative to the subject or can be positioned at a fixed position relative to the subject during transmission of the ultrasound into the subject and during receipt of the ultrasound from the subject; and

a processor for generating an ultrasound image from the ultrasound received as the transducer is moved relative to the subject and for generating an ultrasound image from the ultrasound received when the transducer is positioned at the fixed position relative to the subject, wherein the ultrasound image generated from the ultrasound received by the moving transducer can have a frame rate of 15 frames per second (fps) or greater.

110. (new) The system of claim 109, wherein at least a portion of the transmitted ultrasound penetrates a membrane before being transmitted into the subject.

111. (new) The system of claim 109, wherein the ultrasound is transmitted into the subject from a location external to the subject.

112. (new) The system of claim 109, wherein the transducer is moved relative to the subject along an arcuate path.

113. (new) The system of claim 112, wherein the transducer oscillates along the arcuate path at a frequency of at least 15Hz.

114. (new) The system of claim 109, wherein the ultrasound image generated from the ultrasound received when the transducer is positioned at a fixed position is an M-mode image.

115. (new) The system of claim 109, wherein the ultrasound image generated from the ultrasound received when the transducer is positioned at a fixed position is a Doppler image.